Climate Change and Human Health Literature Portal

National Institute of Environmental Health Sciences

Integrated analysis of water quality parameters for cost-effective faecal pollution management in river catchments

Abstract:

In many parts of the world, microbial contamination of surface waters used for drinking, recreation, and shellfishery remains a pervasive risk to human health, especially in Less Economically Developed Countries (LEDC). However, the capacity to provide effective management strategies to break the waterborne route to human infection is often thwarted by our inability to identify the source of microbial contamination. Microbial Source Tracking (MST) has potential to improve water quality management in complex river catchments that are either routinely, or intermittently contaminated by faecal material from one or more sources, by attributing faecal loads to their human or non-human sources, and thereby supporting more rational approaches to microbial risk assessment. The River Ouse catchment in southeast England (U.K.) was used as a model with which to investigate the integration and application of a novel and simple MST approach to monitor microbial water quality over one calendar year, thereby encompassing a range of meteorological conditions. A key objective of the work was to develop simple low-cost protocols that could be easily replicated. Bacteriophages (viruses) capable of infecting a human specific strain of Bacteroides GB-124, and their correlation with presumptive Escherichia coli, were used to distinguish sources of faecal pollution. The results reported here suggest that in this river catchment the principal source of faecal pollution in most instances was non-human in origin. During storm events, presumptive E. coli and presumptive intestinal enterococci levels were 1.1-1.2 logs higher than during dry weather conditions, and levels of the faecal indicator organisms (FIOs) were closely associated with increased turbidity levels (presumptive E. coli and turbidity, r Euro Surveillance (Bulletin Europeen Sur Les Maladies Transmissibles; European Communicable Disease Bulletin) 0.43). Spatio-temporal variation in microbial water quality parameters was accounted for by three principal components (67.6%). Cluster Analysis, reduced the fourteen monitoring sites to six representative 'sentinel' sites. The correlation coefficient between presumptive E. coli and phages of Bacteroides GB-124 was very small (r Euro Surveillance (Bulletin Europeen Sur Les Maladies Transmissibles; European Communicable Disease Bulletin) 0.05) whilst that between turbidity and suspended solids was high (r Euro Surveillance (Bulletin Europeen Sur Les Maladies Transmissibles; European Communicable Disease Bulletin) 0.62). Variations in climate, animal and anthropogenic interferences were all, either directly or indirectly, related to faecal contamination. The findings show the importance of meteorological conditions, such as storm events, on microbial water quality, and suggest that any future increases in the frequency of storm events (associated with climate change) are likely to result in a greater incidence of FIO/pathogen loads. This low-cost approach could help to predict spatio-temporal 'hotspots' of elevated waterborne disease risk. The work also represents an important step towards integrating novel MST tools into river catchment modelling.

Climate Change and Human Health Literature Portal

Communication: ☒

resource focus on research or methods on how to communicate or frame issues on climate change; surveys of attitudes, knowledge, beliefs about climate change

 A focus of content

Communication Audience: ☒

audience to whom the resource is directed

 Policymaker

Early Warning System: ☒

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

 A focus of content

Exposure : ☒

weather or climate related pathway by which climate change affects health

 Extreme Weather Event, Food/Water Quality

   Extreme Weather Event: Other Extreme Event

     Extreme Weather Event (other): Storms

   Food/Water Quality: Chemical, Pathogen

Geographic Feature: ☒

resource focuses on specific type of geography

 Freshwater

Geographic Location: ☒

resource focuses on specific location

 Non-United States

   Non-United States: Europe

     European Region/Country: European Country

     Other European Country : England

Health Impact: ☒

specification of health effect or disease related to climate change exposure

 Infectious Disease

   Infectious Disease: Foodborne/Waterborne Disease

Foodborne/Waterborne Disease: General Foodborne/Waterborne Disease

Intervention: ☒

strategy to prepare for or reduce the impact of climate change on health

 A focus of content

Mitigation/Adaptation: ☒

mitigation or adaptation strategy is a focus of resource

 Adaptation

Resource Type: ☒

format or standard characteristic of resource

 Research Article

Timescale: ☒

time period studied

 Time Scale Unspecified

Vulnerability/Impact Assessment: ☒

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

 A focus of content